EVALUATION OF BUCCAL BONE PENETRATING PROPERTY OF 4% ARTICAINE WITH 1:100,000 ADRENALINE VERSUS 2% LIGNOCAINE WITH 1:80,000 ADRENALINE CLASSIC INFERIOR ALVEOLAR NERVE BLOCK TECHNIQUE IN ADULT PATIENTS UNDERGOING ERUPTED MANDIBULAR MOLAR TEETH EXTRACTION

Dissertation Submitted to

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

In partial fulfillment for the Degree of

MASTER OF DENTAL SURGERY

BRANCH III

ORAL MAXILLOFACIAL SURGERY

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CERTIFICATE

This is to certify that this dissertation titled **"EVALUATION OF BUCCAL BONE PENETRATING PROPERTY OF 4% ARTICAINE WITH 1:100,000 ADRENALINE VERSUS 2% LIGNOCAINE WITH 1:80,000 ADRENALINE CLASSIC INFERIOR ALVEOLAR NERVE BLOCK TECHNIQUE IN ADULT PATIENTS UNDERGOING ERUPTED MANDIBULAR MOLAR TEETH EXTRACTION"** is a bonafide record of work done by **Dr.PRASHANTHI.G** under our guidance and to our satisfaction during her postgraduate study period **2009-2012.**

This Dissertation is submitted to **THE TAMILNADU Dr. M.G.R.MEDICAL UNIVERSITY,** in partial fulfillment for the award of the Degree of **MASTER OF DENTAL SURGERY – ORAL AND MAXILLOFACIAL SURGERY, BRANCH III.** It has not been submitted (partial or full) for the award of any other degree or diploma.

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INTRODUCTION

Local anesthesia plays the most important role for pain control in dentistry. The first substance used for pain control in dentistry was cocaine, as far back as in 1884. In 1903, Abel discovered Adrenaline .Broun suggested using adrenaline as a "chemical tourniquet"as it prolongs the duration of local anesthetic agent. In 1904 Einhorn synthesized procaine, an ester anesthesia. In the 1940's a new group of local anesthetic compounds, the amides, were introduced. A Swedish chemist Nils Lofgren, synthesized lignocaine, an Amide Local anesthetic agent in 1943 which revolutionized pain control in dentistry worldwide, as it was both more potent and less allergenic than procaine. In the succeeding years, other amide local anaesthetics (prilocaine in 1953 by Lofgren and Tegner, bupivacaine and mepivacaine in 1957 by A. F. Ekenstam, etidocaine in 1971 by Takman) were introduced. These local anesthetic agents provide pulpal anesthesia for periods lasting from 20 minutes (mepivacaine) to as long as three hours (bupivacaine and etidocaine with adrenaline). In addition, these popular drugs proved to be more rapid-acting than the older ester-type drugs and, at least from the perspective of allergenicity, safer.

In 1969, Rusching et al. prepared a new drug, Articaine in Germany, where it entered clinical use in 1976. It was first named Carticaine, but its generic name was changed to Articaine in 1984. In April 2000, the U.S. Food and Drug Administration granted approval for the sale of 4% Articaine with

1:100,000 adrenaline in the United States under the name of Septocaine (Septodont). 4% Articaine with 1:100,000 adrenaline is a safe local anesthetic for use in clinical dentistry in both adults and children[11,14,30]. Articaine hydrochloride is an amide local anesthetic, 4-methyl-3[2-(propyl-amino) propionamido]-2 thiophenecarboxylic acid, methyl ester hydrochloride.

Articaine differs from other amide local anesthetics in that it contains a thiophene group, which increases its liposolubility, and is the only widely used amide local anesthetic that also contains an ester group. The ester group enables articaine to undergo biotransformation in the plasma (hydrolysis by plasma esterase) as well as in the liver (by hepatic microsomal enzymes). The primary metabolite, articainic acid, is inactive. Articaine and its metabolites are eliminated via the kidneys. Approximately 5 percent to 10 percent of articaine is excreted unchanged [29,38,51].

Action of Articaine is similar to other local anesthetics in reversibly blocking nerve conduction [1,7,6,8,12,26,27,29,30,36,37,41,43,44,46,52]. Adrenaline is included in the clinical formulation both to retard absorption of articaine, thereby prolonging the duration of clinically adequate anesthesia, and to minimize systemic absorption of the active drug. Though Articaine is available as 4% with 1:100,000 or 1:200,000 adrenaline, according to Carlos.F.Santos et al's[5] study conducted both the solutions had equal latency, duration of post-operative analgesia ,duration of anesthetic actions on soft tissues , intra-operative bleeding and hemodynamic parameters.

The onset of anesthesia 4% Articaine 1:100,000 adrenaline is 1.5 to 1.8 minutes for maxillary infiltration and 1.4 to 3.6 minutes for inferior alveolar nerve block. The duration of soft-tissue anesthesia for 4% articaine 1:200,000 adrenaline is 2.25hrs for maxillary infiltration and 4hrs for nerve block[30]. The anesthetic activity of articaine/adrenaline combinations has been demonstrated to be comparable to that of other anesthetic combinations, including lidocaine/ epinephrine, mepivacaine / levonordefrin and prilocaine / epinephrine [1,7,6,8,12,26,27,29,30,36,37,41,43,44,46,52].

Inferior alveolar nerve block is the most commonly used anesthetic technique for various dental procedures in the mandibular teeth. This technique is a difficult technique for beginners and has the highest failure rate owing to several factors, including, difficulty in identification of landmarks, and complications like trismus, heamatoma formation, facial nerve palsy etc. Supplementary injections can be useful in overcoming such failure[18,19,26]. Rosenberg and colleagues[44] showed articaine and lignocaine to have a similar efficacy for pain reduction when given as a supplemental buccal infiltration for inadequate pulpal anesthesia during endodontic procedures. Additionally, the combination of a buccal and lingual infiltration of lignocaine has been shown to be more effective than buccal alone in obtaining pulpal anesthesia of lower anterior teeth [38] .

However, buccal and buccal plus lingual infiltrations of articaine with epinephrine did not differ in their efficacy in obtaining pulpal anesthesia for mandibular permanent first molars [20].

The recent work done by Robertson and collegues [13] showed that Buccal infiltration of 4% Articaine with 1:100,000 adrenaline is more effective than a similar injection of 2% Lidocaine with 1:100,000 adrenaline in obtaining pulp anesthesia in mandibular molars of healthy volunteers .The success of mandibular infiltration with 4% articaine and adrenaline for first molar anesthesia is comparable to that of an inferior alveolar nerve block with 2% lignocaine and epinephrine when similar outcome measures are used. A recent blinded crossover study by Il – Young Jung[21] indirectly compared the two techniques, with statistically comparable success of around 50% for articaine infiltration and lignocaine inferior alveolar nerve blocks for mandibular first molar anesthesia. Anesthetic efficacy of 4% articaine with1: 100,000 adrenaline infiltrations for first molar pulp anesthesia was similar to that of an Inferior alveolar nerve block using 2% Lignocaine with 1: 80,000 adrenaline over 30minutes. The discomfort of buccal infiltration with articaine was dependent on the volume injected and similar to that of an Inferior alveolar nerve block.

Mandible is made of thick cortical bone. Due to the increased thickness of the buccal bone when compared to maxillary bone which is thin porous and cancellous, local infiltration of 2% Lignocaine with 1:80,000 adrenaline

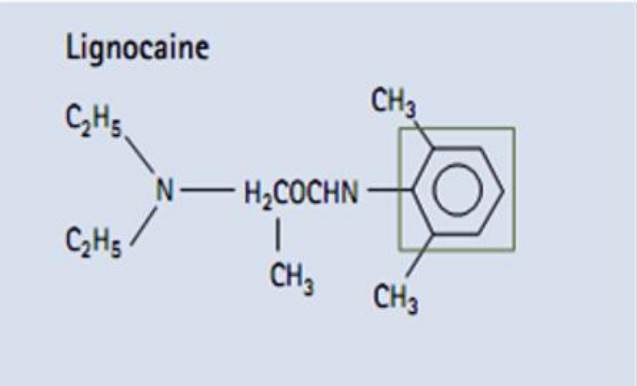
cannot penetrate the bone efficiently and produce pulpal anesthesia when local infiltration injection given. Even for a single molar tooth extraction inferior alveolar nerve block technique supplemented with buccal nerve infiltration has been the choice to anesthetize the tooth before extraction. Studies have shown that 4% Articaine with 1:100,000 has excellent buccal bone penetrating property and can anesthetize the pulp satisfactorily during root canal therapy.

This study has been designed to evaluate and compare the anesthetic efficiency of 4% Articaine with 1:100,000 adrenaline using local buccal and lingual infiltration injection technique versus 2% Lignocaine with 1:80,000 adrenaline using conventional inferior alveolar nerve block technique in adult patients undergoing mandibular erupted first and second molars extraction.

PHARMACOLOGY

Lignocaine (2-Diethylamino 2',6 –acetoxylidide hydrochloride) ia the most commonly used amide local anesthetic. Lignocaine is metabolized in the liver into monoethyiglyceine and xylidide by microsomal fixed function oxidases. Xylidide is a local anesthetic and potentially toxic. Lignocaine is excreted via kidneys, less than 10% unchanged, more than 80% various metabolites. It's anesthetic half –life is about 90 minutes (1.6 hrs).

The manufacturer's maximum recommended dose of lidocaine with epinephrine is 6.6mg /kg and without adrenaline is 4.4mg/kg.



Articaine (4-methyl-3-[2-(propylamino) - propionamido]-2-thiophene-carboxylic acid, methyl ester hydrochloride) is a unique amide LA in that it contains a thiophene, instead of a benzene ring. The

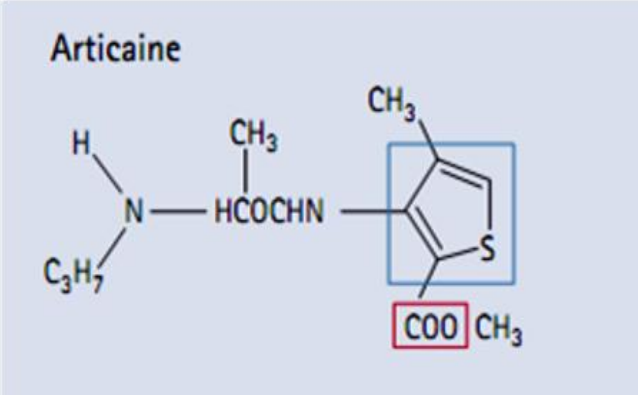
thiophene ring allows greater lipid solubility and potency as a greater portion of an administered dose can enter neurons. It is the only amide anaesthetic containing an ester group, allowing hydrolysation in unspecific blood esterases. Articaine's amide linkage undergoes bio-transformation in the liver, a relatively slow process, however articaine is additionally inactivated by serum esterases, a fast process commencing immediately after injection.

About 90% of articaine metabolises quickly via hydrolysis in the blood into its inactive metabolite articainic acid, which is excreted by the kidney in the form articainic acid glucuronide. The elimination serum half-life of articaine is 20 minutes and of articainic acid is 64 minutes. Equal analgesic efficacy and a lower systemic toxicity (a wide therapeutic range) allows articaine use in a concentration higher than other amide LAs.

It is believed that local saturation of serum esterases, causing slower and prolonged metabolism, may contribute to the advantageous relationship between persistence of the local anesthetic effect and low systemic toxicity. The maximum recommended dosage for articaine with epinephrine is 7mg /kg.

The increased duration of the local anaesthetic effect may also be related to the high degree of protein binding, where the increased tendency for articaine to attach securely to the protein receptor site may provide a longer duration of clinical activity. There is no correlation

between the serum concentration and local anaesthetic effect of articaine[26].



AIMS AND OBJECTIVES

To assess the anesthetic efficacy of 4% Articaine with 1:1,00,000 adrenaline given as buccal and lingual infiltration in adult patients undergoing erupted mandibular first and second molar extraction.

REVIEW OF LITERATURE

Dudkiewicz A (1987) [11] **.,** Fifty children with a mean age of 7 years, ranging from 4-10 years, were enrolled in a study comprising the application of mandibular infiltration using articaine hydrochloride for conventional operative dentistry of posterior primary mandibular teeth. Articaine hydrochloride produced an appropriate deep anesthesia in all treated patients. The authors have recommended that mandibular infiltration using articaine is effective and safe and has a potential of being the technique of choice.

Muller .W.P et al (1991) [34] **.,** conducted a study to know the, exact blood concentrations resulting from the use of the local anesthetics .They stated that due to the high vascularity a rapid increase in serum local anesthetic levels is to be expected. Due to analytical problems, the literature provides controversial statements about the pharmacokinetics of articaine which is generally used for this block. The given half-life periods following intramuscular application range from 39 min 8 to 31 h 6. For this reason, mandibular nerve blocks with 2 ml 4% articaine with 1:200,000 epinephrine were carried out in 10 awake patients and 10 patients during intubation anesthesia. The blood samples from peripheral veins showed an average maximum concentration of 2.1 1.3 mg/l after 12.5 2.5 min. After 8 h the value had fallen below the minimum detection limit of 0.05 mg/l. In the present study, a half-life of approximately 20 min was determined for articaine after conduction anesthesia. This local anesthetic holds an exceptional position

because as an amide-type local anesthetic it contains an additional ester group that is hydrolytically metabolized in the blood. The concentration of the resulting metabolite reached a maximum value of 2.6 1.6 mg/l after 40 to 50 min. they concluded that compared to other amide-type local anesthetics, whose terminal plasma half-life varies between 1 and 3.6 h 5, the value of 20 min found for articaine is very low. This is in part due to its structure, as the ester group is rapidly metabolized by plasma esterases. Because of its rapid breakdown articaine is very suitable for use in oral surgery. The HPLC method represents an uncomplicated analytical technique for the determination of local anesthetics levels in blood and other body fluids.

Kimmo Vahatalo et al (1993) [27]., conducted a study to compare the anesthetic properties of articaine hydrochloride with 1:2,00,000 epinephrine and lidocaine with 1:80,000 epinephrine for maxillary infiltration anesthesia. They found no statistically significant differences between the articaine and lidocaine solutions with respect to onset and duration of action.

Celia Mc Lean et al (1993) [7] ., conducted a study to measure the degree of anesthesia obtained with 4% prilocaine and 3% mepivacaine compared with 2% lidocaine (1:100,000 epinephrine) for inferior alveolar nerve block. Using a repeated measures design, 30 subjects randomly received an inferior alveolar injection using masked cartridges of each solution at three successive appointments. The first molar, first premolar, lateral incisor, and contralateral canine (control) were blindly tested with an Analytic Technology

pulp tester at 3-min cycles for 50 min. Anesthetic success was defined as no subject response to the maximum output of the pulp tester (80 reading) within 16 min and maintenance of this reading for 50 min. Although subjects felt numb subjectively, anesthetic success as defined here occurred in 43 to 63% of the molars, in 53 to 67% of the premolars, and in 30 to 37% of the lateral incisors. No statistically significant differences in onset, success, or failure were found among the solutions. They conclude that the three preparations are equivalent for an inferior alveolar nerve block of 50-min duration.

Hass et al (1995) [18] ., A retrospective study of paresthesia following the injection of local anaesthetic in dentistry from 1973 to 1993 has been done. Only those cases in which surgery was not conducted were considered in this study. From 1973 to 1993, there were 143 reports of paresthesia not associated with surgery. No significant differences were found with respect to patient age, patient gender, or needle gauge. All reports involved anaesthesia of the mandibular arch, with the tongue most frequently reported to be symptomatic, followed by the lip. Pain was reported in 22% of the cases. Paresthesia was reported most often following the injection of articaine and prilocaine. In 1993 alone, there were 14 reports of paresthesia not associated with surgery. This can be projected to an incidence of 1:785000 injections. Articaine was administered in 10 of these cases and prilocaine in the other four. The observed frequencies of paresthesia following the administration of articaine or prilocaine were significantly greater than the expected frequencies for these

agents, based on the distribution of local anaesthetics use in Ontario in 1993. Authors suggested that local anaesthetic formulation 20s might have the potential for mild neurotoxicity.

Jakobs W Ladwig B (1995) [22] ., have studied the pharmacokinetics of articaine in children. The maximum values were distinctly lower with the 2% articaine solution. The plasma clearance was distinctly earlier than in comparable investigations in adults. They have recommended that there is no need to fix a lower mg/kg articaine dose limit for children because of age-related differences in the pharmacokinetics and the use of 2% articaine in pediatric dentistry is particularly advantageous because of the lower C max and the shorter half-life.

Childers M et al (1996) [8] **.,** conducted a study whose objective was to compare the anesthetic efficacy of the intraligamentary injection of 4% articaine with 1:100,000 epinephrine and of 2% lidocaine with 1:100,000 epinephrine, administered with computer-controlled local anesthetic delivery system, in mandibular posterior teeth. The study design was a crossover design, intraligamentary injections of 1.4 mL of 4% articaine with 1:100,000 epinephrine and of1.4 mL of 2% lidocaine with 1:100,000 epinephrine who were randomly a dministered with a computer-controlled local anesthetic delivery system, in a double-blind manner on the mesial and distal aspects of a mandibular first molar, at 2 separate appointments to 51 subjects. A pulp tester was used to test for anesthesia, in 2-minute cycles for 60 minutes, of the mandibular first and second molars and second premolar. Anesthesia was

considered successful when 2 consecutive 80 readings (highest output) were obtained within 20 minutes. The results showed successful pulpal anesthesia was obtained 86% of the time for the first molar using the articaine solution and 74% of the time using the lidocaine solution. There were no significant differences ($P < .05$) between the articaine and lidocaine solutions

The mean onset times of pulpal anesthesia for the first molar were 1.3 minutes with articaine solution and 2.2 minutes with lidocaine solution. Duration of pulpal anesthesia for the first molar was 34 minutes for the articaine solution and 31 minutes for the lidocaine solution. They concluded that the efficacy of 4% articaine with 1:100,000 epinephrine was similar to the efficacy of 2% lidocaine with 1:100,000 epinephrine for intraligamentary injections.

Bircher.A.J et al (1996) [4] ., A case of 43 year old woman who suffered from recurrent localized swellings and an eczematous dermatitis starting one day after an injection of lignocaine has been reported. The investigators confirmed hypersensitivity with intradermal patch and lymphocyte transformation tests, which revealed sensitization to lignocaine and cross-reactivity to the other aminoacylamide local anesthetics bupivacaine, mepivacaine and prilocaine, but not to articaine. Contact allergy to the ester local anesthetics benzocaine, procaine and tetracaine, the quinoline or aminoacylamide cinchocaine, and the preservatives methylparaben and metabisulfite, was excluded. They also did a subcutaneous challenge test with articaine, which was well tolerated.

Oertal et al (1997) [39] **.,** studied the pharmacokinetics of Articaine and concluded that it is the most widely used local anaesthetic agent in dentistry in a number of European countries. The amide structure of articaine is similar to that of other local anaesthetics, but it contains an additional ester group which is quickly hydrolysed by esterases. High performance liquid chromatography has been used to determine the concentrations of articaine and its metabolite articainic acid in serum. Rapid sample preparation is critical in the accurate determination of articaine serum concentrations, since blood and serum are the sites of metabolism. The time to maximum drug concentrations of articaine occurs about 10 to 15 minutes after submucosal injection of articaine 4% 80mg, irrespective of epinephrine (adrenaline). The mean maximum plasma drug concentration is about 400 μg/L for articaine with epinephrine 1:200,000 and 580 μg/L for articaine without epinephrine. The elimination half-time of articaine is about 20 minutes. The rapid breakdown of articaine to the inactive metabolite articainic acid is related to a very low systemic toxicity and consequently to the possibility of repeated injections. Equal analgesic efficacy along with lower systemic toxicity (i.e. a wide therapeutic range) permits the use of articaine in higher concentrations than other amide-type local anaesthetics. Complete anaesthesia can be observed in nearly 90% of all cases, using articaine 4% 60 to 80mg with epinephrine 1: 200 000. Articaine is better able to diffuse through soft tissue and bone than other local anaesthetics. The concentration of articaine in the alveolus of a tooth in the upper jaw after extraction was about 100 times

higher than that in systemic circulation. The plasma protein binding rate of articaine and articainic acid is 70%. It has been concluded that an unintentional intravascular injection of articaine 80mg does not cause toxic effects in healthy individuals.

Simon et al (1997) [46] , A study was done to know the effectiveness of three local anesthetic agents for intravenous regional anesthesia in the upper limb. Side effects and plasma concentrations of the drugs in the doses administered for IVRA were also studied. The time of onset for sensory block was significantly shorter (2.5 minutes) in the articaine group than in the lignocaine group (11.1 minutes) or the prilocaine group (10.9 minutes). Development of motor block was equal in all three groups. Maximum concentrations of articaine, lignocaine, and prilocaine were, 1.85, 8.5, and 4.4 micrograms/ml, respectively. It was found that articaine had the fastest onset of sensory block and the lowest peak plasma concentration of the three local anesthetics when used for intravenous regional anesthesia.

Oertal et al (1999) [40] ., Study was done to evaluate the effect of age on pharmacokinetics of the local anesthetic agent articaine**.** Submucosal infiltration anesthesia from two different dosages of 4% articaine without epinephrine was compared in healthy elderly and young volunteers. High performance liquid chromatography has been used to determine concentrations of articaine in serum. Basic pharmacokinetic parameters were calculated according to standard procedures. The area under the serum concentration time curve and maximum drug concentration (Cmax) values did not differ

significantly with age; however, both parameters tended to be higher in elderly volunteers. No changes in terminal half-life and time to reach maximum serum concentration (tmax) were observed and concluded that the metabolism of articaine is age independent. No change of dosage of articaine in elderly patients should be necessary.

Stanley F. Malamed et al (2000) [29] ., In a study three identical randomized blind multi center trials subjects between 4-80 years of age received 4% articaine with 1:100000 epinephrine or 2% lignocaine with 1:100,000 epinephrine for simple or complex procedures. The authors found no statistical difference between the two treatment groups with respect to subject or investigator pain ratings using the VAS and concluded that 4% articaine was well tolerated in 882 subjects. Articaine provided clinically effective pain relief during most dental procedures and had a time of onset and duration of anesthesia appropriate for clinical use.

Schertzer et al (2000) [44] , In his letter quires substantial reasons to utilize 4% articaine instead of usual 2% lignocaine and the maximum dose of articaine able to safely inject during a single dental appointment. Malamed has replied that clinical observations indicate that articaine possesses two features that doctors find important; faster onset of action and "You don't miss as often" and clinical significance in minimizing the risk of overdose as elimination half life of most amide local anesthetics is approximately 90 minutes where as that of articaine is 27 minutes.

Giovana Radomille Tofoli et al (2000) [17]., compared 20 healthy volunteers and evaluated the anesthetic efficacy of 4% articaine in association with 2 different concentrations of epinephrine, 1;2,00,000 and 1:1,00,000 in inferior alveolar nerve block. They concluded that both solutions presented the same clinical effectiveness in blocking the inferior alveolar nerve.

Carrera I et al (2000) [6]., conducted a study to observe the hemodynamic changes during surgical extraction of lower third molars induced by three local anesthetics solutions associated with different vasoconstrictors. Three groups were established according to the anesthetic solution and associated vasoconstrictor administered (4% articaine + epinephrine 1:200,000, 3% mepivaciane without vasoconstrictor, and 3% prilocaine + felypressin 1:1,850,000). Heart rate, systolic and diastolic pressure, and oxygen saturation were recorded at different times before, during and at the end of surgery, along with the type and amount of anesthetic solution administered. The study variables were found to be more stable with articaine + epinephrine 1:200,000, although the three studied solutions caused no significant hemodynamic changes with respect to the basal values when administered in healthy patients subjected to surgical removal of a lower third molar.

Staneley F. Malamed et al (2001) [30] ., Conducted a study to compare the safety and efficacy of articaine (4 percent with epinephrine 1:100,000) to lignocaine. A total of 1,325 subjects participated in these studies, 882 of them received articaine 4 percent with epinephrine 1:100000. The overall incidence

of adverse events in the combined studies was 22 percent for the articaine group and 20 percent for the lignocaine group. The most frequently reported adverse events in the articaine group, excluding post procedural dental pain, were headache (4 percent), facial edema, infection, gingivitis and paresthesia (1 percent each).

J.G. Meechan (2002) [24]., described supplementary techniques available to provide pulpal anesthesia and concluded that when conventional techniques fail, supplementary techniques increase the incidence of pulpal anesthesia when used in combination with standard techniques.

Van Eden S P Patel M F et al (2002) [50] ., Articaine is the most widely used local anesthetic in a number of European countries, and is been in use in UK since 1998. It is said to have a number of advantages, namely, low systemic toxicity due to rapid breakdown to an inactive metabolite articainic acid; rapid onset of surgical analgesia (2.2min) faster elimination time than lignocaine; Better diffusion through soft tissue and bone than other local anesthetics; and lack of toxic effects in healthy individuals following unintentional intra vascular injection.

Zolkowska D et al (2000) [53] ., compared the interaction between local anesthetics and centrally acting antihypertensive drugs and concluded that articaine is the most safe local anesthetic and can be used in epileptic patients .Co- administration of local anesthetics with centrally acting antihypertensive drugs did not influence seizures activity in mice.

Dogan N et al (2003) [12]., an animal study forty rats were used to know the wound response with articaine. The rats were randomly separated into 4 groups. Three groups were given 2% lignocaine, 4% articaine, or injectable saline and the fourth was a control group. Skin specimens underwent the breaking strength test and histologic examination at one week after the surgical procedure. The skin specimens of the rats were subjected to a pulling force of 10mm/min across the incision line. The strength value at the moment of breaking in the tissue was expressed in Newton. Histologic examination was performed as well, and wound healing was graded. Both the histologic grade and BST values in the lignocaine and articaine groups were significantly lower than those of the control and saline groups. Similarly, the histologic and BST values of the articaine and lignocaine groups were statistically significant. Some necrotic regions were observed at the incision region in two samples from the articaine group. Authors have concluded that articaine is as safe a local anesthetic agent as lignocaine from the standpoint of wound response.

Wynn RL et al (2003) [52]., A review of reports of incidence of paresthesia and recent reports of increased incidence of paresthesia with use of articaine has been done. Taking account of total number of cartridges used during 1993 and 1994 projected an incidence of 2.98 paresthesia cases per million injections of prilocaine and 2.05 cases per million injections of articaine. One of the authors is an oral surgeon, believes articaine is well tolerated and effective but has not found any clinical advantages, and how

ever suggests that articaine is safer when a procedure requires multiple injections. They have commented that articaine has slightly greater or equal incidence compared to other local anesthetics.

Nusstein J, Berlin J et al (2004) [36]., A comparison of pain of injection, heart rate increase, and post injection pain of the intraligamentary injection of 4% articaine with 1:100,000 epinephrine and 2% lignocaine with 1:100,000 epinephrine administered with a computer-controlled local anesthetic delivery system has been done. Results demonstrated the incidence of moderate pain was 14%-27% with needle insertion, with 0%-4% reporting severe pain. For solution deposition, moderate pain was reported 8%-18% of the time, with no reports of severe pain. There were no significant differences between the articaine and lignocaine solutions. Regarding heart rate changes, neither anesthetic solution resulted in a significant increase in heart rate over baseline readings.

Claffey, Elizabeth et al (2004) [9] ., The purpose of this prospective, randomized, double-blind study was to compare the anesthetic efficacy of 4% articaine with 1:100,000 epinephrine to 2% lidocaine with 1:100,000 epinephrine for inferior alveolar nerve blocks in patients experiencing irreversible pulpitis in mandibular posterior teeth. Seventy-two emergency patients diagnosed with irreversible pulpitis of a mandibular posterior toothrandomly received, in a double-blind manner, 2.2ml of 4% articaine with 1:100,000 epinephrine or 2.2ml of 2% lidocaine with 1:100,000 epinephrine using a conventional inferior alveolar nerve block. Endodontic

access was begun 15 min after solution deposition, and all patients were required to have profound lip numbness. Success was defined as none or mild pain (Visual Analogue Scale recordings) on endodontic access or initial instrumentation. The success rate for the inferior alveolar nerve block using articaine was 24% and for the lidocaine solution success was 23%. There was no significant difference ($p < 0.89$) between the articaine and lidocaine solutions. Neither solution resulted in an acceptable rate of anesthetic success in patients with irreversible pulpitis.

Oliveira P.C et al (2004)[41]., The purpose of this study was to evaluate the onset of action of pulpal and soft tissue anaesthesia, and pain experience after buccal and palatal infiltrative injections with 4% articaine with 1:100,000 adrenaline, and 2% lignocaine with 1:100,000 adrenaline. A double blind cross-over study was conducted with 20 healthy adult subjects who, in two appointments at least two weeks apart, randomly received an infiltration anaesthesia with the solutions in the buccal and palatal regions of the upper right canine. The tooth was tested with a pulp tester before (to establish its baseline response), and after the injection, until return to the base threshold level. The pain experience caused by palatal injection was verified by the visual analogue scale (VAS). Data were analysed using Wilcoxons test (alpha = 0.05).There were no significant statistical differences between the solutions with respect to VAS ($p = 0.45$), onset of action ($p = 0.80$) and pulpal ($p = 0.08$) and soft tissue ($p = 0.18$) anaesthesia duration, although pulpal anaesthesia may have reached statistical

significance if a higher number of volunteers had been used. Under the conditions of this study it can be concluded that both anaesthetic solutions showed similar pain experience.

Costa CG et al (2005) [10] **.,** Twenty healthy patients who received 1.8 ml of one of the three local anesthetics during operative dental procedures were examined. Onset and duration were determined by electric pulp tester. Onset time was 2.8 1.6,1.4 minutes and duration were 39.2, 56.7and 66.3 minutes respectively for 2% lignocaine with 1:100000 epinephrine 4% articaine with 1:200000 epinephrine and 4% articaine with 1:100000 epinephrine. They concluded that articaine produced shorter onset and longer duration of action of pulpal anesthesia by maxillary infiltration than lignocaine.

Vree and Gielen (2005) [51]**.,** have stated in their study that the concentration of articaine in the alveolus of a tooth in the upper jaw after extraction was about 100 times higher than that in systemic circulation articaine is metabolized via hydrolysis into articainic acid, 75% of which is excreted as the acid; 25% of the acid is excreted, in the glucuronidated form, by the kidney the half-lives of elimination of articaine are 0.6 and 2.5 hours, whereas the apparent half-life of the metabolite articainic acid is 2.5 hours. Intrinsic half-lives of articainic acid are: t1⁄2 a 12 minutes, and t1⁄2 b 64 minutes (1 hour). The renal excretion of articainic acid and glucuronide is 100%, with 25%glucuronidation by the kidney.

Nusstein J (2005) [37] **.,** A prospective, randomized, double blind study to compare the degree of pulpal anesthesia obtained with 4% articaine with 1:100000 epinephrine and 2% lignocaine with 1:100000 epinephrine in inferior alveolar nerve blocks has been done. Using a crossover design, inferior alveolar nerve blocks were randomly administered, in a double-blind manner, using 4% articaine with 1:100000 epinephrine and 2% lignocaine with 1:100000 epinephrine, at two separate appointments, to 57 subjects. Using the articaine solution, successful pulpal anesthesia ranged from 4 to 54% from the central incisor to the second molar. Using the lignocaine solution, successful pulpal anesthesia ranged from 2 to 48%. The authors have concluded that 4% articaine with 1:100000 epinephrine was similar to 2% lignocaine with 1:100000 epinephrine in inferior alveolar nerve block.

El-Qutob D (2005) [15] **.,** reported the case of a 51-year-old woman who had an immediate skin reaction after subcutaneous administration of a local anesthetic composed of articaine and epinephrine before a dental procedure. The patient subsequently underwent further dental procedures without local anesthetic. Skin prick tests performed with commercial local anesthetics (lignocaine, mepivacaine, bupivacaine and articaine) turned negative except for articaine.

Hillerup S (2005) [19] **.,** Fifty two patients were examined who fifty-four injection injuries had caused by mandibular block analgesia affecting the lingual nerve (42) and/or the inferior alveolar nerve (12). The perception of feather light touch, pinprick, sharp/dull discrimination, warm, cold, point

location, brush stroke direction, 2-point discrimination and pain perception were assessed. Gustation was tested for recognition of sweet, salt, sour and bitter. They found that mandibular block analgesia causes lingual nerve injury more frequently than inferior alveolar nerve injury and observed all grades of loss of neurosensory and gustatory functions were found, and a range of persisting neurogenic malfunctions was reported. Subjective complaints and neurosensory function tests indicate that lingual nerve lesions are more incapacitating than inferior alveolar nerve lesions. Fifty-four percent of the nerve injuries were associated with Articaine 4%. They commented that unlike most mechanical injuries after surgery, injection injuries were not followed by a course of spontaneous improvement of neurosensory and/or gustatory function indicating neurotoxicity as a central etiological factor.

Feck AS et al (2005) [16] **.,** Local anesthetic failures in dental patients can have many causes, including anatomical variations, technique and anxiety/fear. By understanding the mechanisms responsible for failed local anesthesia, patients can be treated more comfortably. Oral sedation dentistry is highlighted as a way to reduce anxiety/fear and the patient's perception of pain. Profound anesthesia can be accomplished more easily in relaxed patients with diminished or eliminated anxiety/fear.

Philip Mikesell et al (2005) [43] **.,** conducted a study to compare degree of pulpal anesthesia obtained with 4% articaine with 1:1,00,000 epinephrine and 2% lidocaine with 1:1,00,000 epinephrine in inferior alveolar nerve block.

They concluded that both solutions were similar in obtaining the pulpal anesthesia.

D.Ram et al (2006) [14] .,Fifty children with a mean age of 7 years, ranging from 4-10 years, were enrolled in a study comprising the application of mandibular infiltration using articaine hydrochloride for conventional operative dentistry of posterior primary mandibular teeth. Articaine hydrochloride produced an appropriate deep anesthesia in all treated patients.

The authors have recommended that mandibular infiltration using articaine is effective and safe and has a potential of being the technique of choice.

Jason Bigby et al (2006) [23] ., conducted a study to determine the anesthetic efficacy and heart rate effect of 4% articaine with 1:1,00,000 epinephrine for supplemental intraosseous injection in mandibular posterior teeth diagnosed with irreversible pulpitis. They concluded that when inferior alveolar nerve block fails to provide profound pulpal anesthesia, the intraosseous injection of 4% articaine with 1:1, 00,000 epinephrine would be successful 86% of times in achieving pulpal anesthesia in mandibular posterior teeth of patients presenting with irreversible pulpitis.

Mohammad Dib Kanna et al (2006) [33] ., conducted a randomized, controlled trial of 31 healthy volunteers compared 4% articaine with 1:100,000 epinephrine buccal infiltration to buccal plus lingual infiltration of the same dose of drug in achieving pulpal anesthesia of mandibular first molar teeth. Data were compared with efficacy of an inferior alveolar nerve block

using 2% lidocaine 1:80,000 epinephrine in a cohort of 27 of the volunteers. Anesthesia was determined using electronic pulp testing. Buccal and buccal plus lingual infiltrations of articaine with epinephrine did not differ in efficacy in obtaining pulpal anesthesia for mandibular permanent first molars ($p = 0.17$). Efficacy of 4% articaine with epinephrine infiltrations for first molar pulp anesthesia was similar to that of an IANB using lidocaine with epinephrine over a 30-minute study period (96 and 80 episodes of no response to maximal stimulation respectively, $p = 0.097$). Subjective tooth numbness was more common after IANB than buccal infiltration ($p = 0.005$). The concluded that discomfort of buccal infiltration with articaine was volume dependent ($p = 0.017$) and similar to that of an IANB.

Sollecito et al (2006) [47]., The authors conducted two double-blinded, randomized, multicenter clinical trials to determine the efficacy and clinical anesthetic characteristics of 4 percent articaine hydrochloride (HCl) with 1:200,000 epinephrine (A200) as compared with those of 4 percent articaine HCl with 1:100,000 epinephrine (A100) and 4 percent articaine HCl without epinephrine and concluded that inclusion of epinephrine in 4 percent articaine anesthetic formulations is essential for achieving profound anesthesia. The authors found that the A200 formulation provided a level of pulpal anesthesia comparable with that of the A100 formulation.

Paul A. Moore et al (2006) [42]., conducted a double blinded, randomized, multi centric clinical trials to determine the efficacy and clinical

anesthetic characteristics of 4% articaine with 1:2,00,000 (A200) epinephrine as compared to 4% articaine 1:1,00,000 (A100) epinephrine and 4% articaine without epinephrine. They concluded that inclusion of epinephrine in 4% articaine anesthetic formulations is essential for achieving profound anesthesia. They found that A200 provided a level of pulpal anesthesia comparable with that of A100 formulation.

Carlos. F. Santos et al (2007) [5]., compared the use of 4% articaine in association with 1:1,00,000 epinephrine (10 ug/ml ;A100) and 1:2,00,000 epinephrine (5 ug/ml ; A200) in lower third molar removal. They concluded that an epinephrine concentration of 1:1, 00,000 or 1:2, 00,000 in 4% articaine solution does not affect the clinical efficacy of the local anesthetic. It is possible to successfully use the 4% articaine formulation with a lower concentration of epinephrine (1: 2, 00,000or 5 ug/ml) for lower third molar extraction with or without bone removal.

Alejandro Sierra Rebollado et al (2007) [13]., Comparative study is made of the anesthetic efficacy of 4% articaine versus 2% lidocaine, both with epinephrine 1:100,000, in truncal block of the inferior alveolar nerve during the surgical extraction of impacted lower third molars. A randomized double-blind clinical trial was conducted of 30 patients programmed for the bilateral surgical extraction of symmetrical lower third molars in the context of the Master of Oral Surgery and Implantology (University of Barcelona, Barcelona, Spain). Following the obtainment of informed consent, two operators performed surgery on an extemporaneous basis, using as local

anesthetic 4% articaine or 2% lidocaine with the same concentration of vasoconstrictor (epinephrine 1:100,000). The study variables for each anesthetic were: latency (time to action) and duration of anesthetic effect, the amount of anesthetic solution used, and the need of re-anesthetize the surgical zone. A visual analog scale was used to assess pain during surgery, and thus subjectively evaluate the anesthetic efficacy of the two solutions. The results showed thtat statistically significant differences (p = 0.003) were observed in the mean duration of anesthetic effect (220.86 min. for 4% articaine vs. 168.20 min. for 2% lidocaine). Latency, the amount of anesthetic solution and the need to re-anesthetize the surgical field showed clinical differences in favor of articaine, though statistical significance was not reached. The pain scores indicated similar anesthetic efficacy with both solutions. They concluded that 4% articaine offers better clinical performance than 2% lidocaine, par-ticularly in terms of latency and duration of the anesthetic effect. However, no statistically significant differences in anesthetic efficacy were recorded between the two solutions.

Douglas Roubertson et al (2007)[13]., The authors conducted a prospective, randomized, double-blind, crossover study comparing the degree of pulpal anesthesia achieved by means of mandibular first molar buccal infiltrations of two anesthetic solutions: 4 percent articaine with 1:100,000 epinephrine and 2 percent lidocaine with 1:100,000 epinephrine. Each of 60 blinded adult subjects randomly received two buccal infiltrations at the first

molar site: one cartridge of 4 percent articaine with 1:100,000 epinephrine at one appointment and one cartridge of 2 percent lidocaine with 1:100,000 epinephrine at another appointment. The injections were administered during two separate appointments spaced at least one week apart. The authors used an electric pulp tester to assess the first and second molars and the first and second premolars for pulpal anesthesia in three-minute cycles for 60 minutes. They considered anesthesia to be successful when they obtained two consecutive pulp test readings of 80 (meaning the subject evidenced no response at the maximum output on the pulp tester). The results showed that with the lidocaine formulation, successful pulpal anesthesia ranged from 45 to 67 percent. With the articaine formulation, successful pulpal anesthesia ranged from 75 to 92 percent. There was a significant difference ($P < .05$) in anesthetic success between the lidocaine and articaine formulations for each of the four teeth. Pulpal anesthesia declined slowly over 60 minutes with both formulations. They concluded that for mandibular buccal infiltration of the first molar, 4 percent articaine with 1:100,000 epinephrine will result in a higher success rate than will 2 percent lidocaine with 1:100,000 epinephrine, but the duration of pulpal anesthesia will decline over 60 minutes with either formulation.

Rosenberg PA et al (2007) [44]., conducted a randomized, double-blind trial was conducted to compare the efficacy of 4% articaine with 1:100,000 epinephrine and 2% lidocaine with 1:100,000 epinephrine when used as a

supplemental anesthetic. Forty-eight patients with irreversible pulpitis requiring supplemental buccal infiltration for endodontic therapy were given either 4% articaine with 1:100,000 epinephrine or 2% lidocaine with 1:100,000 epinephrine in a double-blind manner. A standard VAS pain scale was used to evaluate the patient's response to pain after a supplemental injection. The mean VAS score after supplemental anesthesia was 15.28 for 4% articaine with 1:100,000 epinephrine and 19.70 for 2% lidocaine with 1:00,000 epinephrine. The mean percentage change in VAS score was 70.5 and 62.2% for articaine and lidocaine, respectively. They concluded that there was no statistically significant difference in the VAS pain score between 4% articaine with 1:00,000 epinephrine and 2% lidocaine with 1:00,000 epinephrine as a supplemental anesthetic.

ll – Young Jung et al (2008) [21]., compared the anesthetic efficacy of inferior alveolar nerve blocks (IANBs) with that of buccal infiltrations (BIs) in mandibular first molars. Using a crossover design, all subjects received a standard IANB or a BI of 1.7 mL of 4% articaine with 1:100,000 adrenaline (Septanest; Septodont, Saint-Maru-des-Fosses, France) on two appointments separated by at least 1 week. Pulpal anesthesia was determined by using an electric pulp tester. Electric pulp testing was repeated at 5, 8, 11, 15, 20, 25, and 30 minutes after the injections. Anesthesia was considered successful if the subject did not respond to the maximum output of the pulp tester at two or more consecutive time points. Fifty-four percent of the BI and 43% of the

IANB were successful; the difference was not significant (p = 0.34). The onset of pulpal anesthesia was significantly faster with BI (p = 0.03). In conclusion, BI with 4% articaine for mandibular first molars can be a useful alternative for clinicians because compared with IANB it has a faster onset and a similar success rate.

Ian P. Corbett, Mohammad D. Kanaa et al (2008)[20]., conducted a randomized, controlled trial of 31 healthy volunteer compared 4% articaine with 1:100,000 epinephrine buccal infiltration to buccal plus lingual infiltration of the same dose of drug in achieving pulpal anesthesia of mandibular first molar teeth. Data were compared with efficacy of an inferior alveolar nerve block using 2% lidocaine 1:80,000 epinephrine in a cohort of 27 of the volunteers. Anesthesia was determined using electronic pulp testing. Buccal and buccal plus lingual infiltrations of articaine with epinephrine did not differ in efficacy in obtaining pulpal anesthesia for mandibular permanent first molars (p< 0.17). Efficacy of 4% articaine with epinephrine infiltrations for first molar pulp anesthesia was similar to that of an IANB using lidocaine with epinephrine over a 30-minute study period (96 and 80 episodes of no response to maximal stimulation respectively, (p< 0.097). Subjective tooth numbness was more common after IANB than buccal infiltration (p< 0.005). The discomfort of buccal infiltration with articaine was volume dependent (p < 0.017) and similar to that of an IANB.

Andrew hasse et al (2008) [2]**.,** The authors conducted a prospective, randomized, double-blind, crossover study comparing the degree of pulpal anesthesia achieved by means of mandibular first molar buccal infiltrations of two anesthetic solutions: 4 percent articaine with 1:100,000 epinephrine and 2 percent lidocaine with 1:100,000 epinephrine after an inferior alveolar nerve (IAN) block with the use of 4 percent articaine with 1:100,000 epinephrine. Seventy-three blinded adult subjects randomly received buccal infiltrations at the first molar site with a cartridge of 4 percent articaine with 1:100,000 epinephrine at one appointment and a cartridge of 2 percent lidocaine with 1:100,000 epinephrine at another appointment after receiving a standard IAN block with the use of 4 percent articaine with 1:100,000 epinephrine in a crossover design. After the injections, the authors used an electric pulp tester to test the first molar for anesthesia in three-minute cycles for 60 minutes. They considered anesthesia to be successful when two consecutive 80 readings were obtained within 10 minutes of the IAN block and infiltration injection, and the 80 reading was sustained continuously through the 60th minute. The authors found that with the use of the 4 percent articaine formulation, successful pulpal anesthesia occurred 88 percent of the time for the first molar. With the 2 percent lidocaine formulation, successful pulpal anesthesia occurred 71 percent of the time. The results show a significant difference ($P < .05$) between the articaine and lidocaine formulations. They concluded that for a mandibular buccal infiltration of the first molar after a standard IAN block, 4 percent articaine with 1:100,000 epinephrine resulted in a higher

success rate (88 percent) than did 2 percent lidocaine with 1:100,000 epinephrine (71 percent success rate).

Leonardo. V.L Gregorio (2008) [28]**.,** compared the clinical efficacy of 4% articaine with 0.5% bupivacaine both with 1: 2,00,000 epinephrine for lower third molar removal. They concluded that in comparison with 0.5% bupivacaine 4%articaine provided a shorter time to onset, and comparable homeostasis and postoperative pain control, with a shorter duration of soft tissue anesthesia in lower third molar removal. They also concluded fewer patients required supplemental intraoperative injections when operated with 4% articaine.

Narasimhan Srinivasan et al (2009) [35]**.,** compared the anesthetic efficacy of 4% articaine and 2% lidocaine (both with 1:100,000 epinephrine) for buccal infiltration in patients experiencing irreversible pulpitis in maxillary posterior teeth and they concluded that The efficacy of 4% articaine was superior to 2% lidocaine for maxillary buccal infiltration in posterior teeth.

Nuzam .F.M et al (2010) [38] **.,** claimed that previous studies have shown higher success rates when using an articaine formulation versus a lidocaine formulation for buccal mandibular first molar infiltrations. However, there is little information on articaine's effect in mandibular anterior teeth. Hence, the authors conducted a prospective, randomized, single-blind, crossover study comparing the degree of pulpal anesthesia obtained with 2 sets of mandibular lateral incisor infiltrations given in 2 separate appointments in

82 adult subjects. One set of infiltrations consisted of an initial labial infiltration of a cartridge of 4% articaine with 1:100,000 epinephrine plus a lingual infiltration of the same anesthetic and dose. The other set of infiltrations consisted of an initial labial infiltration of a cartridge of 4% articaine with 1:100,000 epinephrine plus a mock lingual infiltration. The authors used an electric pulp tester to test the lateral incisor for pulpal anesthesia in 2-minute cycles for 60 minutes after the injections. The results showed that the labial plus lingual infiltration significantly improved the success rate (no response to 2 consecutive 80 readings with the pulp tester) to 98% when compared with a labial infiltration of a cartridge of the same articaine formulation (76% success). They concluded that a combination labial and lingual infiltrations did not provide pulpal anesthesia for an hour.

Anna Guglielmo et al (2011) [3]., conducted a prospective, randomized, single-blind crossover study was to evaluate the anesthetic efficacy of a combination palatal and buccal infiltration of the maxillary first molar. Using a crossover design, 40 subjects received two sets of maxillary first molar infiltrations at two separate appointments spaced at least 1 week apart. The anesthetic used in this study was 2% lidocaine with 1:100,000 epinephrine. One set of infiltrations consisted of a buccal infiltration of 1.8 mL of anesthetic and a palatal infiltration of 0.5 ml of anesthetic. The other set consisted of a buccal infiltration of 1.8 ml of anesthetic and a mock palatal infiltration. The first molar was pulp tested in 4-minute cycles for a total of 60 minutes. Anesthetic success was defined as no subject response to two

consecutive 80 readings with an electric pulp tester. The success rates were 88% for the buccal infiltration and 95% for the buccal plus palatal infiltration. The difference was not statistically significant. The buccal plus palatal infiltration significantly increased the incidence of pulpal anesthesia from 21 minutes through 57 minutes. Although there was an increased incidence of pulpal anesthesia with the combination buccal plus palatal infiltration, anesthesia was not provided for 60 minutes.

J.G. Meechan , Jaber AA et al (2011) [25]., compared the effectiveness of buccal and lingual local anaesthetic injections in the mandibular first molar region in obtaining pulpal anaesthesia in mandibular teeth. Twenty healthy volunteers received 1.8 mL of 4% articaine with 1:100,000 epinephrine as a buccal or lingual infiltration in the mandibular first molar region in a randomized double-blind cross-over design. The responses of the first molar, a premolar and the lateral incisor teeth were assessed using an electronic pulp tester over a 47-min period. Successful anaesthesia was defined as no response to maximum stimulus from the pulp tester on two or more consecutive tests. Success between techniques was analysed using the McNemar test and variations between teeth were compared with Chi-square. Their results showed that the number of no responses to maximum stimulation from an electronic pulp tester was significantly greater for all test teeth after the buccal injection compared with the lingual approach ($P < 0.001$). Successful anaesthesia was more likely following the buccal infiltration compared with the lingual method for molar (65% and 10%, respectively) and

premolar (90% and 15%, respectively) teeth. There was no difference in anaesthetic success for the lateral incisor.they concluded that buccal infiltration at the first mandibular molar is more effective than lingual infiltration in the same region in obtaining anaesthesia of the mandibular first molar and premolar teeth..

K.E.Yupp et al (2011) [26] .,conducted a study for review of literature for articaine in the study they discussed the followings a comprehensive review on articaine use in dentistry, compared other local anaesthetics in different settings, outlined the use of articaine in children, discussed the controversy regarding neurotoxicity and highlighted the quality of the available evidence. They concluded that although there may be controversy regarding its safety and advantages in comparison to other local anaesthetics, there is no conclusive evidence demonstrating neurotoxicity or significantly superior anaesthetic properties of articaine for dental procedures. Articaine is a safe and effective local anaesthetic drug to use in all aspects of clinical dentistry for patients of all ages, with properties comparable to other common local anaesthetic agents. Therefore, at this time, the decision to use articaine cannot be based on any convincing evidence of superiority over other LA drugs, rather the choice will be based on the personal preference and experiences of individual clinicians.

Matthew Martin, John Nusstein et al (2011) [31] **.,** compared 1.8 mL and 3.6 mL 4% articaine with 1:100,000 epinephrine in a mandibular buccal

infiltration of the first molar. The authors conducted a prospective, randomized, single-blind, crossover study comparing the degree of pulpal anesthesia obtained with 1.8 mL and 3.6 mL 4% articaine with 1:100,000 epinephrine as a primary infiltration in the mandibular first molar. Eighty-six asymptomatic adult subjects randomly received a primary mandibular buccal first molar infiltration of 1.8 mL or 3.6 mL 4% articaine with 1:100,000 epinephrine in two separate appointments. The authors used an electric pulp tester to test the first molar for anesthesia in 3-minute cycles for 90 minutes after the injections.the results showed that compared with the 1.8-mL volume of 4% articaine with 1:100,000 epinephrine, the 3.6-mL volume showed a statistically higher success rate (70% vs 50%). They concluded that the anesthetic efficacy of 3.6 mL 4% articaine with 1:100,000 epinephrine is better than 1.8 mL of the same anesthetic solution in a primary mandibular buccal infiltration of the first molar. However, they said that the success rate of 70% is not high enough to support its use as a primary injection technique in the mandibular first molar.

Mayes Mc Entire, John Nusstein et al (2011) [32]., compared the anesthetic efficacy of 4% articaine with 1:100,000 epinephrine versus 4% articaine with 1:200,000 epinephrine as a primary buccal Infiltration in the mandibular first molar and concluded that the anesthetic efficacy of 4% articaine. With 1:200,000 epinephrine is comparable to 4% articaine with 1:100,000 epinephrine in a primary mandibular buccal infiltration of the first

molar. The two 4% articaine formulations showed no statistically significant difference when comparing anesthetic success, onset of anesthesia, or incidence of pulpal anesthesia.

Shahid hussain, B.H. Sripathi rao et al (2011)[45]., compared the efficacy of 4% articaine hydrochloride and 2% lignocaine hydrochloride in the extraction of maxillary premolars for orthodontic reasons. They concluded that articaine can be used as an alternative to lignocaine, for extraction of maxillary premolars for orthodontic reasons due to clinical advantage due to rapid onset, longer duration of action, and greater diffusing property over lignocaine and the elimination of the need for a painful palatal injection were demonstrated.

Suttapreyasri Srisurang et al (2011) [48]., assessed and compare the efficacy of single buccal and palatal infiltration of lidocaine, mepivacaine, or articaine with 1:100 000 epinephrine by maxillary anesthetic injection. A double-blinded, randomized, clinical trial was conducted with 33 patients undergoing upper premolar extraction. The patients were randomly allocated into one of three groups, according to the local anesthetic agent used: 2% lidocaine, 2% mepivacaine, or 4% articaine, all with 1:100 000 epinephrine, and were blinded to the anesthetic used. The extent of anesthetization, pulpal anesthetization in adjacent teeth, pain on injection, and adverse effects of the anesthetic agents were assessed. The results showed that the extent of anesthetization produced by 4% articaine (42 mm) was statistically more significant ($P < 0.05$) than 2% lidocaine (33 mm) and 2% mepivacaine (32.5

mm). The successful anesthetization of adjacent teeth occurred more often in the articaine group than in the lidocaine and mepivacine groups, although not to a statistically significant extent. The pain scores for the injections were comparable between the three groups. They concluded that local anesthetization using 4% articaine with 1:100 000 epinephrine covers a wider area of soft tissue and adjacent teeth than 2% lidocaine or 2% mepivacaine with 1:100,000 epinephrine, which is sufficient for the extraction of one or two teeth.

LIST OF ABBREVIATION USED

C max: Maximum plasma concentration

IVRA: Intravenous regional anesthesia

LA: Local anesthetic

PABA: Para amino benzoic acid

T max: Time taken to reach maximum concentration

VAS: Visual analog scale

MATERIALS AND METHODS

A total sample size of 100 patients undergoing extraction of mandibular posterior teeth reporting to the Dept. of Oral and Maxillofacial Surgery , Ragas Dental College and Hospital, Chennai were planned for our study .Out of which 50 patients were given 4% Articaine with 1:100,000 adrenaline with buccal and lingual infiltration and 50 patients were given 2% Lignocaine with 1:80,000 adrenaline using classic direct inferior alveolar nerve with lingual and buccal nerve block reporting to the Dept. of Oral and Maxillofacial Surgery , Ragas Dental College and Hospital, Chennai.

INCLUSION CRITERIA:

1. Completely erupted mandibular first or second molar teeth either carious or periodontally weak teeth.
2. Patients without allergic to local anesthetic drugs.
3. Age group between 18- 40 years.

EXCLUSION CRITERIA:

1. Periapical abscess in relation to the tooth to be extracted.
2. Space infection.
3. Local infection in relation to the tooth to be extracted.
4. Hypertensive patients.
5. Diabetic patients.

1. Patients with thyroid disorders.
2. Patients with liver diseases.
3. Patients with renal diseases.
4. Patients with bleeding and clotting disorders.
5. Patients under antidepressants medication.
6. Patients with bone diseases and disorders.
7. Patients with altered physiological responses which affects pain perception mechanisms.
8. Any condition which interacts with the mechanism of action of local anesthesia.

MATERIALS USED IN THE STUDY:-(Fig.1-6)

1. 1.7 ml of 4% Articaine HCL with 1:100,000 adrenaline cartridge.
2. 2% Lignocaine HCL with 1:80,000 adrenaline.
3. Disposable syringe 0.45 x 38 mm / 26 x 1 ½. (dia/ gauge x length in cm/ inches).
4. Standard teeth extraction kit with mouth mirror, straight probe, moons probe, lower molar extraction forceps, lower molar root forceps.
5. Breech – loading, metallic, cartridge –type, aspirating syringe.
6. 27 gauge, 40 x 35mm disposable needle.

CLASSIC INFERIOR ALVEOLAR NERVE BLOCK USING 2% LIGNOCAINE WITH 1:80,000 ADRENALINE :-(Fig.7,8)

Landmarks: - Coronoid notch, pterygomandibular raphe, occlusal plane of mandibular posterior teeth.

TECHNIQUE:-

The patient is positioned comfortably in dental chair, the head positioned such that when the mouth is open wide, body of the mandible is parallel to the floor. The index finger or thumb is used to palpate the external oblique ridge on the anterior border of ramus of the mandible and the coronoid notch is identified. The palpating finger is moved lingually across the retro molar trigone and on to the internal oblique ridge. While palpating intra oral mark with thumb the index finger is placed extra orally behind the ramus of mandible to access the anteroposterior width of the ramus of the mandible.

A syringe with a 1 ½ inch 26 gauge needle is then inserted parallel to the occlusal plane of mandibular teeth , at a level bisecting the finger , penetrating the pterygomandibular space. The needle is penetrated into the tissues until the bone is gently contacted on the internal surface of the ramus of the mandible. The needle is withdrawn by 1mm, aspirated and on negative aspiration 1 to 1.5 ml of 2% Lignocaine with 1:80,000 adrenaline solution is deposited slowly over 1 minute. The needle is now withdrawn slowly and

when one half of its inserted depth has been withdrawn, 0.5ml of solution deposited to anesthetize lingual nerve.

Long buccal nerve block using 2% Lignocaine with 1:80,000 Adrenaline:-

Landmarks: mandibular molars, mucobuccal fold.

The index finger was used to pull the buccal soft tissue laterally for better visualization. Using the 26 gauge needle, such that the bevel of the needle facing the bone and syringe aligned parallel with the occlusal plane ,buccal to the teeth ;the needle was inserted into the distobuccal soft tissue of the most distal tooth in the arch. Negative aspiration was confirmed and 0.3 to 0.5ml solution is deposited usually at a depth of 1 or 2mm.

BUCCAL AND LINGUAL INFILTRATION USING 4% ARTICAINE WITH 1:100,000 ADRENALINE:- (Fig.9,10,11)

Landmarks: mucobuccal fold, mucolingual fold.

TECHNIQUE:-

Using breech loading, metallic, cartridge type aspirating syringe 4% Articaine with 1:100,000 adrenaline solution was infiltrated over the buccal and lingual sulcus region in relation to the mandibular molar tooth to be extracted. Aspiration was done before depositing the solution. The needle used was 27 gauge, 40 x 35 mm .About 1.2 ml of solution was deposited below the apex of the roots buccally and 0.5ml below the lingual roots. After waiting for

5 minutes the patients were checked for objective and subjective symptoms of anesthesia.

Subjectively patient was asked about the numbness over the injected site, few patients experienced lower lip numbness after the infiltration. Objective symptom was assessed by checking manually by pressing with the sharp tip of the moon's probe over the buccal and lingual gingival of the tooth to be extracted. If the patient experienced pain during the above an additional 3-4 minutes was waited and the anesthesia rechecked. If the patient still had pain one more cartridge of 1.7ml 4% Articaine with 1:100,000 adrenaline was infiltrated. The procedure was repeated up to 3 cartridges with a maximum dose of 5.1ml.

After 3 cartridges, if the patient still experienced pain, the infiltration procedure was abandoned and a regular inferior alveolar nerve block using 2% Lignocaine with 1:80,000 adrenaline was performed and the tooth extracted.

Evaluation of pain during the procedure:-

Efficacy was determined using a visual analog scale (VAS) ranging from 0 indicating no pain to 10 indicating the worst pain imaginable. The VAS was taken by a different operator to avoid influencing the patients during scoring.

CONSENT LETTER

I, _____ ,the undersigned hereby give my consent for the required Anesthetic and teeth extraction procedure on myself for the study of evaluating the mandibular buccal bone penetrating property of 4% Articaine with 1:1,00,000 adrenaline concentration. A comparative study with 2% Lignocaine with 1:80,000 adrenaline concentration in patients undergoing lower molar removal.

I have been informed and explained the status of my problem, procedure or techniques of the study .I also accept as part of the study protocol thereby voluntarily, unconditionally, freely give my consent without any form of pressure in mentally sound and conscious state to participate in the study.

NAME OF THE PATIENT:

SIGNATURE OF THE PATIENT:

Patient name:

Treatment plan: Age /Sex :

Visual analogue scale scoring sheet

Sr.No.	PATIENT'S RESPONSE
0.	
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

0 - NO PAIN

1 -3 - MILD PAIN

4 -6 - MODERATE PAIN

7 -9 - SEVERE PAIN

10 - WORST PAIN

RESULTS

The study was performed over a period of 19 months. 100 patients participated in the study for the extraction of mandibular first and second molar. Out of the 100 patients, 50 patients were randomly selected for 4% Articaine with 1:100,000 adrenaline buccal and lingual infiltration and 50 patients for 2% Lignocaine with 1:80,000 adrenaline for classic inferior alveolar nerve block.

In the 4% Articaine with 1:100,000 adrenaline group, 5 patients underwent extraction of mandibular first and second molar simultaneously, these 5 patients are discussed separately. Hence, the sample size is uneven. 50 patients for 2% Lignocaine with 1:80,000 adrenaline group and 45 patients for 4% Articaine group with a total sample size of 95 individuals. (Table.1, Table.2)

Demographic data :-(Graph .1)

The patients selected for the present study were within the age group of 20- 40 years. Mean age group for 2% Lignocaine with 1:80,000 adrenaline was 31.4 + /- 7.9 years ,out of which 27 individuals were females and 23 were males. Mean age group for the 4% Articaine 1:100,000 adrenaline group was 30.2 +/- 6.4 years, out of which 21 individuals were females and 19 were males.

Drug volume:- (Graph .2)

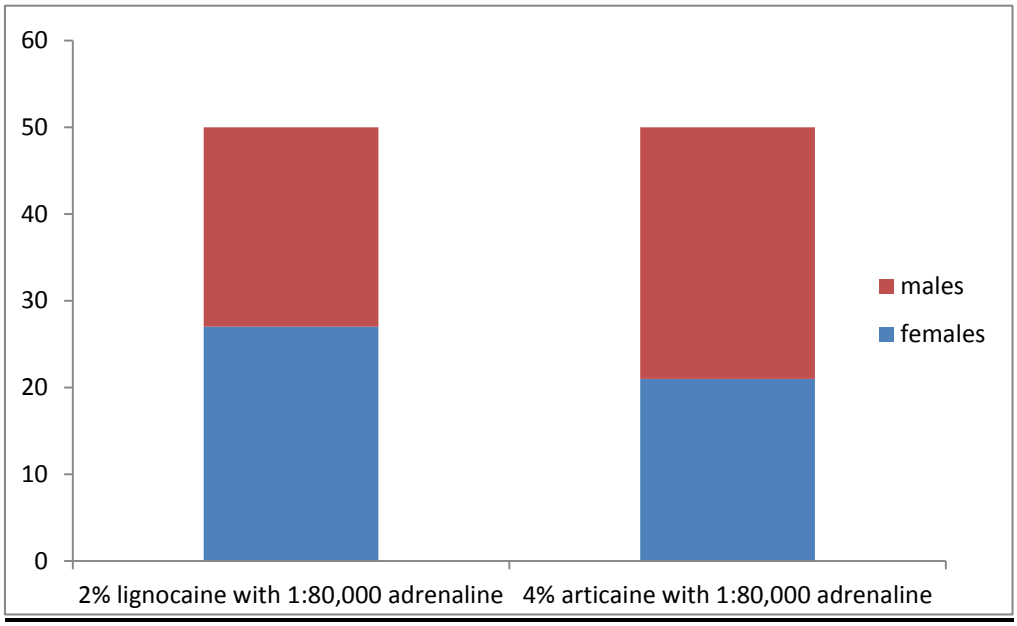
We administered as much as drug that was necessary to achieve adequate anesthesia in all the subjects within normal limited dosages. The mean drug volume was 3.3+/-1.1ml, ranging from 2.5- 5ml for 2% Lignocaine with 1:80,000 adrenaline group and 3.08 +/- 4.3ml, ranging from 1.8 to 5.4ml for 4% Articaine with 1:100,000 adrenaline group.

Pain ratings:- (Table.3) (Graph .3)

The pain ratings for both the groups were analyzed using Visual Analogue Scale. Data was entered and analysed using SPSS (10.05). Mann – Whitney 'U' test was employed to assess the efficacy of 4% Articaine with 1:100,000 adrenaline buccal and lingual infiltration in comparison to 2% Lignocaine with 1:80,000 adrenaline classic inferior alveolar nerve block. $P < 0.05$ was considered to be statistically significant. We found no statistical difference between the two treatment groups with respect to pain using VAS scoring system.

The mean pain score for 2% Lignocaine with 1:80,000 adrenaline group was 1.16 +/- 1.8 and for 4% Articaine with 1:100,000 adrenaline was 2.0+/- 3.0 with a mode of 0 for both the groups.

Graph.1: DEMOGRAPHIC DATA



Graph.2: MEAN DRUG VOLUME

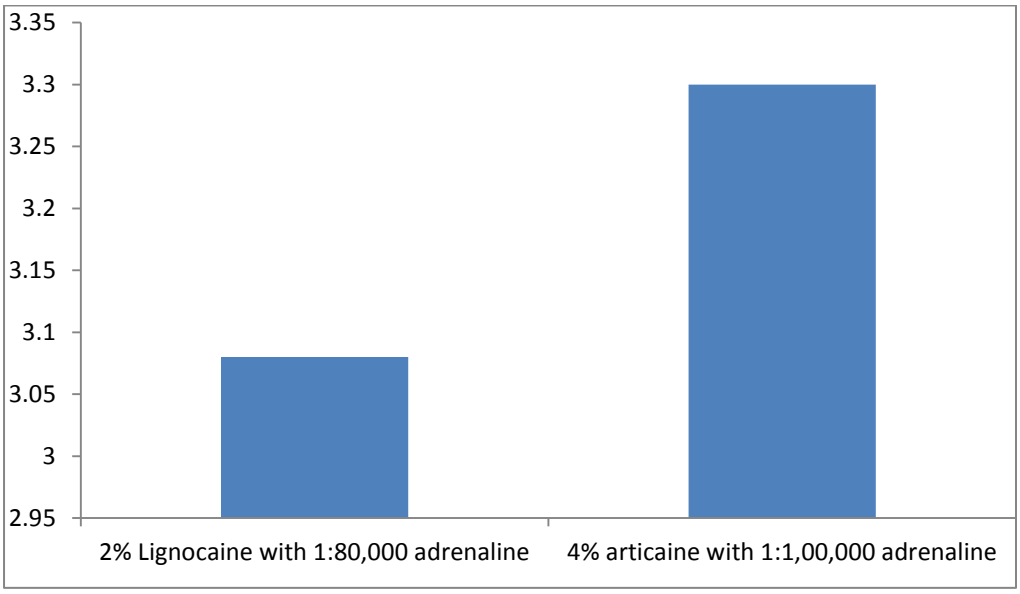
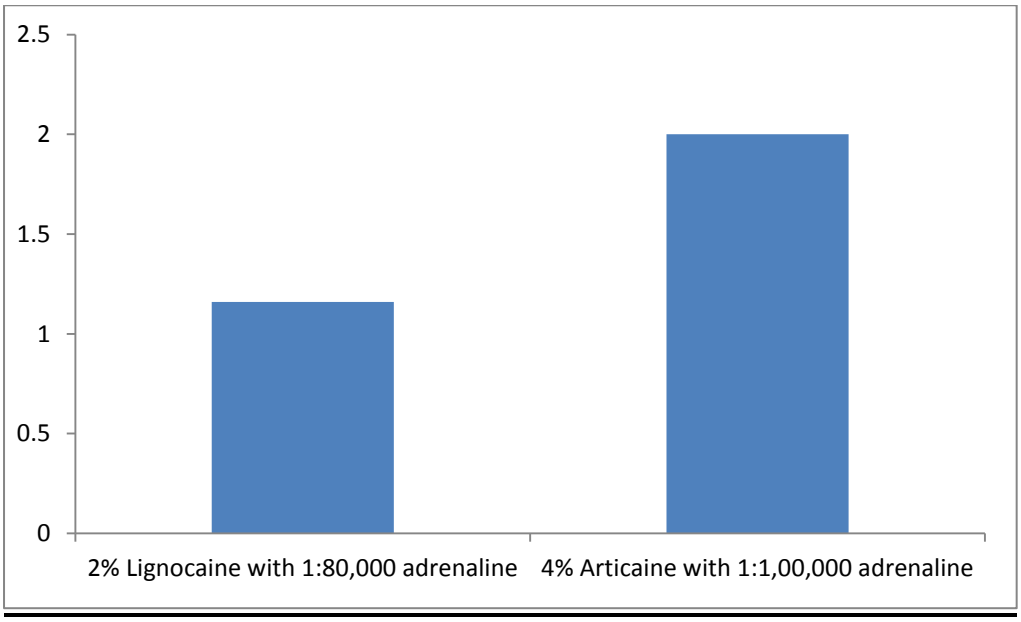


Table.3: COMPARISION OF PAIN SCORES BETWEEN 2%LIGNOCAINE WITH 1:80,000 ADRENALINE AND 4% ARTICAINE WITH 1:1,00,000 ADRENALINE

Group	N	Mean+/- S.D	Mode	P - Value
2% Lignocaine with 1:80,000 adrenaline	50	1.16 +/- 1.8	0	0.338
4% Articiane with 1:100,000 adrenaline	45	2.0 +/-3. 0	0	
Total	95			

Graph.3: MEAN PAIN SCORE



DISCUSSION

Using local anesthetics to control a patient's pain is one of the most important factors for successful treatment. Articaine is not exactly a new drug. Articiane was identified in the older, mostly German literature as articaine, carticaine, or HOE 40 045. Articaine is unique among available amide local anesthetics because it has a thiophene moiety rather than the typical benzene group. Articaine unlike other amide local anesthetics undergoes biotransformation in both liver and plasma thus cleared more quickly from the body [29,38,51].

Articaine has a reputation of providing an improved local anesthetic effect. The available literature indicates that articaine is equally effective when statistically compared to other local anesthetic [1,7,6,8,12,26,27,29,30,36,37,41,43,44,46,52] . Here the results of a randomized clinical trial are discussed, 4% Articaine with 1:100,000 adrenaline being compared with 2% Lignocaine with 1:80,000 adrenaline for purpose of evaluating the efficacy of Articaine. 2% Lignocaine with 1:80,000 adrenaline is chosen as a reference substance, as its effects are well documented [29]. Since the study used identical protocols, the result obtained were comparable, combined analysis of the trial was valid.

Articaine is manufactured as a 4% local anesthetic solution .This is in contrast to Lignocaine which is a 2% solution .Equal analgesic efficacy along

with lower systemic toxicity allows use of articaine in higher concentration than other amide type local anesthesia [39].

This is advantageous with respect to the required bone penetration and hence it is possible to inject smaller volumes thereby minimizing the injection induced pain.

4% Articaine is combined with either 1:100,000 adrenaline or 1: 200,000 adrenaline. Numerous studies have evaluated anesthetic activity of articaine in these 2 distinct concentrations of epinephrine [5,17,32,47] .In one such study conducted by Elliot V. Hersh [5] various haemodynamic parameters were evaluated between 4% articaine with 1:100,000 and 1:200,000 adrenaline such as systolic pressure, diastolic pressure, mean pressure, oxygen saturation and found that the pharmacokinetic profile between A100 and A200 were similar. However they cautioned the use of A100 in patients with cardiovascular diseases.

In our study the inclusion criteria was specific not to include such patients hence, we continued the use of 4% Articaine with 1:100,000 adrenaline.

Various studies have compared anesthetic efficacy of 2% Lignocaine with 1:80,000 adrenaline versus 4% Articaine with 1:100,000 adrenaline given as a supplementary buccal infiltration after a classical inferior alveolar nerve block technique in cases of inadequate lower mandibular molar anesthesia for various dental procedures and concluded that 4% Articaine with 1:100,000 adrenaline infiltration was higher or similar in efficiency to

lignocaine [2,13,32,44]. Il – Young Jung et al [21] indirectly compared the anesthetic efficacy of 4% articaine with 1:100,000 adrenaline buccal infiltration to 2% Lignocaine with 1:80,000 adrenaline Inferior alveolar nerve block. He concluded that 4% articaine with 1:100,000 adrenaline buccal infiltration for mandibular first molar can be used as an alternative for 2% Lignocaine 1:80,000 adrenaline Inferior alveolar nerve block as Articaine infiltration has faster onset and similar success rate. However he suggested that further studies are needed to compare the effectiveness of both the methods directly.

The advantages of 4% Articaine with 1:100,000 adrenaline infiltration over 2% Lignocaine with 1:80,000 adrenaline classical Inferior alveolar nerve block are that 4% Articaine infiltration is a simpler technique than classic 2% Lignocaine Inferior alveolar nerve block, articaine infiltration anesthetizes less soft tissue [24], has shorter duration of anesthesia as it is metabolized both in the liver and plasma[26,29,39],avoids trismus and non- surgical paresthesia as a result of damage from the needle to inferior alveolar and lingual nerves [18,19,26]. It reduces concentration related neurotoxicity[18,19]. Articaine infiltration can be advantageous in hemophilic patients in order to reduce the chances of dangerous hemorrhage [24].

The results of the present study shows infiltration anesthesia efficacy in the mandibular molar region with 4% Articaine with 1:100,000 adrenaline in adults of approximately 51.1%. Therefore the study provides evidence to support the view that mandibular buccal and lingual infiltration with 4%

Articaine with 1:100,000 adrenaline can be as effective as an classic Inferior alveolar nerve block with 2% Lignocaine with 1:80,000 adrenaline in adult patients undergoing erupted mandibular first and second molar teeth extraction.

Buccal infiltration with 4% Articaine with 1:100,000 adrenaline has been shown to achieve higher success rates in mandibular molar anesthesia than that reported with a buccal infiltration of 2% Lignocaine with 1:100,000 adrenaline. This increase in efficacy may be as a result of a concentration effect or greater diffusion of articaine because of the thiophene ring which helps the anesthetic agent to readily diffuse through the buccal bone [20].

Factors influencing the latency of anesthesia are intrinsic properties of the drug, anesthetic technique and it is directly influenced by the corresponding pKa value - smaller pKa values being associated to a shorter latency. The pKa of 4% articaine solution being 7.8 [1] .

In our study of 100 patients there were no adverse effects or complications observed although there are few study reports showing increased incidence of nerve alterations , paresthesia and hyperesthesia with 4% Articaine Inferior alveolar nerve block [18,19], we did not encounter any adverse effects during or after the procedure with the 4% Articaine infiltration. Keeping the efficacy in mind, articaine is a safer local anesthetic agent similar to other group if local anesthetics [26].

In this study, out of the total 100 patients 50 patients were randomly selected for 2% Lignocaine with 1:80,000 classic inferior alveolar nerve block and 50 patients for 4% Articaine with 1:100,000 adrenaline buccal and lingual infiltration undergoing lower mandibular first or second molar extraction. Out of the 50 patients in the articaine group 5 patients underwent extraction of both the mandibular first and second molar teeth. Hence they are discussed separately to avoid bias. Out of the 5 patients 2 patients underwent extraction of 46, 47 and 3 patients underwent extraction of 36, 37. Two patients out of the total 5 needed the use of additional 2.5ml of 2% lignocaine block after the use of 3 cartridges (5.4 ml) of 4% articaine. The VAS pain score being 10& 4 with the use 4% Articaine in these patients. The remaining 3 patients received 5.4 ml, 1.8ml, 3.6 ml of articaine with VAS pain score of 2, 1, 0 respectively.

In the present study we found VAS scores between 0 to 10 and no significant difference in pain experience with 4% articaine or 2% lignocaine. In the articaine group 51.1% of patient reported no pain, 26.6% mild pain , 4.4% moderate pain, 13.3% sever pain and 4.4% worst pain. In the lignocaine group 58% of patients reported no pain, 30% mild pain, 8% moderate pain, 4% sever pain. The average pain score for 4% articaine group was 2.0 + /- 3.0 and for lignocaine group was 1.16 +/- 1.8. The pain scores between both the groups were analyzed using Mann – Whitney ‘U’ test with a P Value of 0.338 obtained. Hence no significant difference in pain score was established between both the groups.

Pain measurement is difficult to establish, because its perception and intensity are multifactorial, encompassing sensorial and affective factors. Multiple variable factors exist like technique variability, anatomic variations, complexity of procedure and reporting error. Pain itself is multifactorial; perception and pain reaction varies greatly among individuals Although VAS may show deficiencies regarding understanding and perception, it provides a validated and meaningful measure of anesthetic efficiency, being used for this purpose by many authors.

To the best of our knowledge, no study has compared the efficacy of 4% Articaine with 1:100,000 adrenaline buccal and lingual local infiltration versus 2% Lignocaine with 1:80,000 adrenaline Inferior alveolar nerve block for the extraction of erupted mandibular first and second molar in adults.

SUMMARY AND CONCLUSION

A classic inferior alveolar nerve block technique is technique sensitive with high failure rates [24] and complications when compared to a buccal and lingual infiltration (field block technique) [18,19]. Due to the thick cortical buccal plate 2% Lignocaine 1:80,000 adrenaline cannot penetrate the bone and anesthetize the adult mandibular molar teeth. Hence for a single mandibular molar tooth extraction Inferior alveolar nerve block is inevitable .But 4% Articaine 1:100,000 adrenaline has been advantageous for the surgeon which anesthetizes the mandibular molar tooth adequately only by buccal and lingual infiltration and allows to complete the tooth extraction procedure successfuly thereby avoiding many complications of Inferior alveolar nerve block. This study recommends the use of 4% Articaine with 1:100,000 adrenaline to be given as buccal and lingual infiltration in adult patients undergoing erupted mandibular molar teeth extraction. However, further studies are needed to estimate the onset, duration of anesthesia and their use in cases of irreversible pulpitis in case of erupted mandibular teeth extraction in adults.

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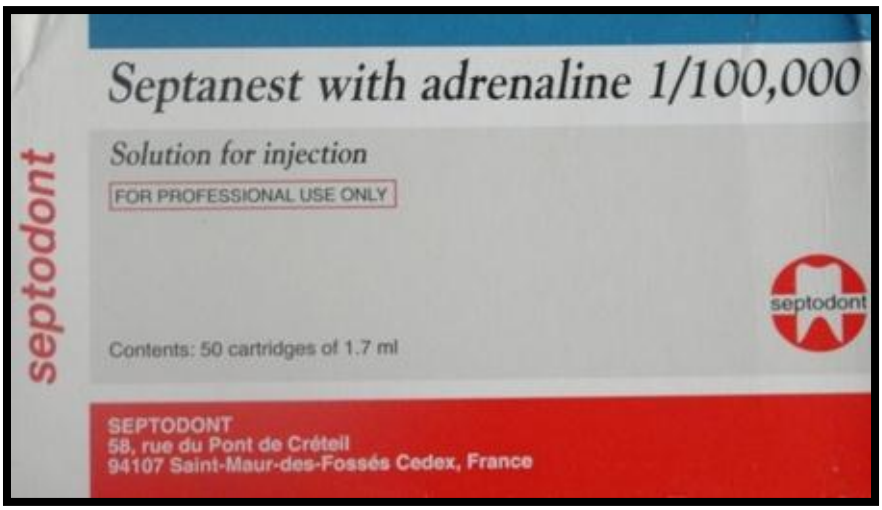

Fig.1: 4% ARTICAINE WITH 1:100,000ADRENALINE CARTRIDGE PACKAGE

Fig.2: 4 % ARTICAINE WITH 1:1,00,000 ADRENALINE CARTRIDGE

Fig.3: BREECH LOADED METALLIC ASPIRATING TYPE SYRINGE , 4% ARTICAINE WITH 1:1,00,000 ADRENALANE CARTRIDGE , DISPOSABLE NEEDLE

Fig.4: EXTRACTION KIT WITH 4% ARTICAINE WITH 1:1,00,000 ADRENALINE

Fig.5: 2% LIGNOCAINE WITH 1:80,000 ADRENALINE BOTTLE

Fig.6: 1 ½ INCH 26 GAUGE NEEDLE AND PLASTIC SYRINGE

Fig.7: CLASSIC INFERIOR ALVEOLAR AND LINGUAL NERVE BLOCK TECHNIQUE USING 2% LIGNOCAINE WITH 1:80,000 ADRENALINE

Fig.8: BUCCAL NERVE BLOCK USING 2% LIGNOCAINE WITH 1:80,000 ADRENALINE

Fig.9:MANDIBULAR MOLAR TOOTH WITH PERIODONTITIS

Fig.10: BUCCAL INFILTRATION

Fig.11: LINGUAL INFILTRATION

Table.1: 2 %LIGNOCAINE WITH 1:80,000 ADRENALINE INFERIOR ALVEOLAR NERVE BLOCK

Patient no	Age	Sex	Tooth extracted	Kind of pathology	Amount of lignocaine used	Pain score
1	36 yrs	F	36	CARIES	2.5ml	0
2	30 yrs	M	36	CARIES	2.5 ml	0
3	40 yrs	M	46	PERIODONTITIS	2.5 ml	0
4	20 yrs	M	46	CARIES	2.5 ml	0
5	28 yrs	F	46	CARIES	5 ml	1
6	24 yrs	F	36	CARIES	2.5 ml	1
7	39 yrs	M	47	CARIES	5 ml	7
8	24 yrs	M	36	CARIES	2.5 ml	0
9	30 yrs	F	37	CARIES	2.5 ml	0
10	25 yrs	F	47	CARIES	5 ml	0
11	35 yrs	F	36	CARIES	2.5 ml	0
12	36 yrs	M	37	CARIES	5 ml	2
13	27 yrs	F	46	CARIES	2.5 ml	1
14	20 yrs	F	36	CARIES	5 ml	1
15	33 yrs	F	46	CARIES	2.5 ml	0
16	32 yrs	M	46	CARIES	2.5 ml	0
17	35 yrs	F	37	CARIES	5 ml	0
18	25 yrs	F	37	CARIES	2.5 ml	0
19	30 yrs	M	47	CARIES	2.5 ml	0
20	38 yrs	M	37	CARIES	5 ml	0
21	24 yrs	F	47	CARIES	2.5 ml	7
22	24 yrs	F	46	CARIES	5 ml	2
23	20 yrs	F	47	CARIES	2.5 ml	3
24	36 yrs	F	46	CARIES	2.5 ml	0
25	40 yrs	M	36	CARIES	2.5 ml	2
26	26 yrs	F	46	CARIES	5 ml	1
27	26 yrs	M	36	CARIES	2.5 ml	2
28	30 yrs	F	36	CARIES	2.5 ml	0
29	32 yrs	M	37	CARIES	5 ml	0
30	30 yrs	M	46	CARIES	2.5 ml	0
31	20 yrs	M	36	CARIES	2.5 ml	1
32	21 yrs	F	37	CARIES	2.5 ml	1
33	39 yrs	M	46	CARIES	2.5 ml	0
34	40 yrs	F	36	CARIES	5 ml	3
35	31 yrs	M	47	CARIES	5 ml	3
36	37 yrs	F	36	CARIES	5 ml	5
37	37 yrs	F	36	CARIES	2.5 ml	0
38	40 yrs	F	36	CARIES	2.5 ml	1
39	24 yrs	M	37	CARIES	2.5 ml	0
40	27 yrs	M	47	CARIES	2.5 ml	0
41	36 yrs	M	46	CARIES	2.5 ml	0
42	40 yrs	M	37	CARIES	5 ml	0
43	32 yrs	M	37	CARIES	2.5 ml	0
44	33 yrs	F	36	CARIES	5 ml	4
45	39 yrs	F	46	CARIES	5 ml	5
46	39 yrs	M	47	CARIES	2.5 ml	0
47	40 yrs	F	37	CARIES	2.5 ml	0
48	38 yrs	M	37	CARIES	2.5 ml	5
49	32 yrs	F	46	CARIES	2.5 ml	0
50	34 yrs	F	47	PERIODONTITIS	2.5 ml	0

Table.2: 4% ARTICAINE WITH 1:1,00,000 ADRENALINE BUCCAI AND LINGUAL INFILTRATION

Patient no	Age	Sex	Tooth Extracted	Kind of pathology	Amount of Articaine used	Pain score	Lignocaine	Pain score after use of lignocaine
1	20yrs	F	36	CARIES	1.8 ml	0		
2	40yrs	M	37	PERIODOTITIS	1.8 ml	0		
3	29yrs	M	46	CARIES	5.4 ml	4	+	0
4	20yrs	M	36	CARIES	3.6 ml	0		
5	36yrs	F	46,47	CARIES	5.4 ml	10	+	0
6	20yrs	F	46	CARIES	3.6 ml	1	+	0(2B)
7	30yrs	F	47	CARIES	5.4 ml	7		
8	32yrs	F	37	CARIES	3.6 ml	0		
9	32yrs	F	36,37	CARIES	5.4 ml	4	+	0
10	21 yrs	F	37	CARIES	1.8 ml	0		
11	40 yrs	M	37	CARIES AND PERIODONTITIS	3.6 ml	0		
12	25 yrs	M	36	CARIES	5.4 ml	7	+	7
13	22yrs	M	36,37	CARIES	5.4 ml	2		
14	38 yrs	M	47	PERIODONTITIS	3.6 ml	0		
15	26 yrs	F	46	CARIES	1.8 ml	0		
16	34 yrs	F	46	CARIES	1.8 ml	0		
17	20 yrs	F	36	CARIES	1.8 ml	0		
18	25 yrs	M	36	TOOTH FRACTURE	3.6 ml	8		
19	20 yrs	F	46	CARIES	3.6 ml	7	+	0
20	40 yrs	F	36	CARIES	1.8 ml	0		
21	35 yrs	M	46	CARIES	1.8 ml	0		
22	38 yrs	F	37	RCT AND FRACTURED	3.6 ml	3	+	0
23	23 yrs	M	36	CARIES	3.6 ml	0		
24	21yrs	F	46	CARIES	1.8 ml	1		
25	32 yrs	M	36	CARIES	1.8 ml	1		
26	21 yrs	M	36	CARIES	3.6 ml	10		
27	40 yrs	M	46	PERIODONTITIS	1.8 ml	0		
28	39 yrs	M	37	PERIODONTITIS	1.8 ml	0		
29	34 yrs	M	36	CARIES	3.6 ml	1		
30	38 yrs	M	46	CARIES	3.6 ml	0		
31	38 yrs	F	47	PERIODONTITIS	1.8 ml	0		
32	40 yrs	F	37	CARIES	1.8 ml	1		
33	30yrs	M	46,47	CARIES	1.8 ml	1		
34	20 yrs	M	36	CARIES	3.6 ml	0		
35	40 yrs	M	47	PERIODONTITIS	5.4 ml	0		
36	36 yrs	M	46	PERIODONTITIS	3.6 ml	0		
37	20 yrs	M	36	CARIES	1.8 ml	1		
38	20 yrs	F	46	CARIES	3.6 ml	7	+	0
39	35 yrs	M	36	CARIES	5.4 ml	3	+	0
40	40 yrs	M	36,37	CARIES	3.6 ml	0		
41	26 yrs	M	36	CARIES	1.8 ml	1		
42	25 yrs	M	37	CARIES	3.6 ml	7		
43	39 yrs	M	37	CARIES	3.6 ml	2		
44	36 yrs	F	47	CARIES	1.8 ml	0		
45	25 yrs	F	36	CARIES	1.8 ml	0		
46	35 yrs	M	36	CARIES	5.4 ml	10	+	0

47	20 yrs	F	36	CARIES	3.6 ml	6	+	0
48	24 yrs	M	46	CARIES	5.4 ml	1		
49	40 yrs	M	47	PERIODONTITIS	1.8 ml	0		
50	40 yrs	M	37	PERIODONTITIS	1.8 ml	1		

2B – 2 nerve blocks